Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

In the Matter of	)	
	)	
Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands	)	WT Docket No. 12-70
	)	ET Docket No. 10-142
Fixed and Mobile Services in the Mobile Satellite Service Bands at 1525-1559 MHz and 1626.5-1660.5 MHz, 1610-1626.5 MHz and 2483.5-2500 MHz, and 2000-2020 MHz and 2180-2200 MHz	)	WT Docket No. 04-356
	)	
Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands	)	

COMMENTS OF MOTOROLA MOBILITY, INC.

Motorola Mobility, Inc. ("Motorola Mobility"), hereby responds to the Federal Communications Commission's ("Commission" or "FCC") Notice of Proposed Rulemaking ("NPRM") seeking to promote mobile broadband use of the 2000-2020 MHz and 2180-2200 MHz bands ("2 GHz band").[1] As a leading manufacturer of advanced commercial mobile user equipment, Motorola Mobility offers its views on how the Commission can craft a band plan and other service rules to support robust mobile terrestrial broadband throughout the 2 GHz band while protecting incumbent uses of adjacent band spectrum.

I. INTRODUCTION.

Motorola Mobility supports the Commission's efforts to make more spectrum available for mobile broadband use, including through the introduction of new terrestrial services in the

[1] Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands, WT Docket Nos. 12-70, 04-356, ET Docket No. 10-142, *Notice of Proposed Rulemaking and Notice of Inquiry*, FCC 12-32 (rel. Mar. 21, 2012) ("NPRM").

2 GHz band. To create the greatest likelihood of rapid, successful deployment of AWS-4, the Commission should rely to the greatest extent possible on standards and rules that have already been applied successfully in other terrestrial mobile bands, such as the Commission's existing Part 27 rules that apply to the AWS-1 band.[2] In this regard, the Commission is correct to look to the AWS-1 rules as a model for AWS-4, not only for technical matters such as power limits[3] and co-channel interference protections,[4] but also for other regulatory issues as well.[5] Relying upon this existing framework will facilitate the deployment of mobile terrestrial broadband services, ease the transition of the 2 GHz band from MSS to terrestrial operations, and aid the integration of this spectrum with other commercial mobile bands.

However, the Commission should take other steps to harmonize the treatment of AWS-4 with other commercial mobile bands and address interference concerns, which would facilitate a smooth integration of the new service into the overall commercial mobile ecosystem. First, the Commission should maintain for AWS-4 the same duplex pairing used in the 2 GHz MSS band but adopt a five megahertz shift of the AWS-4 uplink band. Doing so would reduce the potential for interference between AWS-4 and broadband PCS user devices. Second, the Commission should also apply its standard flat 43 + 10 log (P) dB out-of-band emissions attenuation factor at the lower edge of the AWS-4 uplink band, as proposed for the upper edge of the AWS-4 uplink band.[6] This is the standard attenuation factor used in commercial mobile devices and would

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2 *Id.* at ¶ 29.

3 *Id.* at ¶¶ 58-61.

4 *Id.* at ¶ 65.

5 *See, e.g.*, *id.* at ¶¶ 66, 99.

6 *Id.* at ¶ 39

allow for more rapid deployment of AWS-4 devices while providing adequate interference protection for adjacent band devices.

II. THE COMMISSION SHOULD ADOPT A FIVE MEGAHERTZ SHIFT OF THE AWS-4 UPLINK BAND.

Motorola Mobility supports the Commission's determination to maintain for AWS-4 the same duplex pairing used in the 2 GHz MSS band—with uplink operations in the lower portion of the 2 GHz band and downlink in the upper portion. However, under the current band plan, the MSS uplink band at 2000-2020 MHz is separated by only five megahertz from the broadband PCS downlink band at 1930-1995 MHz. The lack of adequate separation between the frequencies that 2 GHz AWS-4 devices would transmit upon and those over which broadband PCS devices receive creates a significant possibility that AWS-4 mobile devices might cause harmful interference to broadband PCS devices.

This device-to-device interference scenario could occur because the five megahertz separation created by the Upper AWS-2 H Block at 1995-2000 MHz will not be sufficient to allow standard filters on LTE devices operating in the 2 GHz band at full power over a ten megahertz channel to adequately protect PCS devices from interference. As illustrated in the attached technical appendix, the filter performance that might be required to protect PCS devices under these circumstances would exceed industry standards by a wide margin. Creating a band plan with this interference challenge could require service providers either (1) to use devices with costly, one-off filters that could create additional challenges with respect to integrating AWS-4 with other commercial mobile bands and would otherwise reduce the marketability of devices, or (2) to implement internal guard bands and power limitations in excess of those required by the rules, which would reduce overall system capacity and performance.

To minimize the potential for harmful interference, the Commission should adopt the band-shift proposal put forth by Ericsson in response to the *2 GHz Public Notice* and suggested in the NPRM.[7] Under this proposal, the Commission would shift the AWS-4 uplink band up five megahertz, resulting in a new pairing of 2005-2025 MHz on the uplink with 2180-2200 MHz on the downlink for AWS-4 operations. Adjusting the AWS-4 uplink frequencies in this way will create the flexibility to maximize the spectral separation between AWS-4 mobile transmitters and broadband PCS mobile receivers while still facilitating full power mobile broadband operations across the entirety of the AWS-4 band. As demonstrated in the attached technical appendix, Motorola Mobility believes that as much as ten megahertz separation would be needed to reduce the risk of interference between the AWS-4 uplink and PCS downlink bands to appropriate levels.[8] Shifting the AWS-4 uplink frequencies as recommended would provide this level of protection.

III. THE COMMISSION SHOULD APPLY ITS STANDARD OUT-OF-BAND EMISSIONS ATTENUATION REQUIREMENT TO THE AWS-4 BAND.

In keeping with the principle of conforming the AWS-4 service rules to the rules applied in other commercial mobile bands, the Commission should apply its typical 43 + 10 log (P) dB out-of-band emissions attenuation factor at both band edges of the AWS-4 uplink band. This is a standard attenuation factor commonly used in commercial mobile devices that has been demonstrated to adequately protect adjacent services from harmful interference. Applying this

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[7] *See* Comments of Ericsson, ET Docket No. 10–142, WT Docket Nos. 04–356, 07–195, at 9 (filed July 8, 2011); NPRM at ¶ 42.

[8] Under the Middle Class Tax Relief and Job Creation Act of 2012, the FCC has the discretion to not auction the H Block spectrum for commercial uses if it determines that doing so will cause harmful interference to other existing services. *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. Law 112-96, §§ 6401(b)(2)(A), (b)(4). If the Commission determines that use of the H Block spectrum for mobile broadband networks would result in such harmful interference, it should reserve this spectrum as a guard band or allocate it for uses that are more compatible with adjacent band services, such as low-power or indoor-only applications.

same factor consistently to AWS-4 mobile devices will allow for easier, speedier, and less costly development of devices for the band and smoother integration of AWS-4 into the Commission's overall commercial mobile band plan. Adopting an alternative out-of-band emissions attenuation factor at the lower band edge of the AWS-4 uplink band could make necessary the use of specialized components in AWS-4 devices or a reduction in allowable device transmitter power – either of which would risk making AWS-4 a one-off service and thereby forfeiting a significant portion of its potential versatility and value.

In general, the NPRM appears to embrace this suggestion: the Commission proposes to adopt the 43 + 10 log (P) dB attenuation factor for out-of-band emissions between adjacent block AWS-4 licensees[9] and at the upper edge of the uplink band.[10] However, the Commission discusses three different proposals for out-of-band emissions at the lower band edge. Currently, 2 GHz MSS operations are required to attenuate out-of-band emissions by 70 + 10 log (P) dB below 1995 MHz and by a linear interpolation between 70 + 10 log (P) dB at 1995 MHz and 43 + 10 log (P) dB at 2000 MHz.[11] In addition to possibly maintaining the existing rule, the Commission also seeks comment on adopting flat attenuation factors of either 70 + 10 log (P) dB or 43 + 10 log (P) dB for emissions between 1995 and 2000 MHz.[12]

As the Commission recognizes in the NPRM, the existing linear interpolation-based rule presents operational challenges because 2 GHz mobile devices do not have sharp enough roll off characteristics to meet this limit when operating at full power.[13] To address these difficulties,

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9 NPRM at ¶ 33.

10 *Id.* at ¶ 44.

11 47 C.F.R. § 25.252(c)(2).

12 NPRM at ¶¶ 37-40.

13 *Id.* at ¶ 37.

3GPP defined an exception for Band 23 (the LTE band class covering the 2 GHz MSS band) to allow for up to 12 dB of additional power reduction below the maximum transmit power ("A-MPR") for mobile devices operating in the 2000-2010 MHz band.[14] While operating devices at reduced power would allow service providers to comply with the current rule, it also would necessarily reduce the overall performance and efficiency of AWS-4 systems, and would add substantial cost to AWS-4 network deployment due to the reduced edge performance and corresponding need for decreased cell size. A 70 + 10 log (P) dB attenuation factor would only amplify these challenges.

The Commission should apply a flat out-of-band emissions attenuation factor of 43 + 10 log (P) dB between 1995 MHz and the lower band edge of the AWS-4 uplink band. Adopting this standard attenuation factor will allow for typical signal roll-off and normal variations in commercial filter performance. By bringing the service rules and device performance into conformity with other commercial mobile bands, this attenuation factor also would eliminate the need to impose extraordinary and costly operational limitations on AWS-4. Moreover, the 70 + 10 log (P) dB attenuation factor below 1995 MHz would not be disturbed, so there would be no increased risk of harmful interference to broadband PCS operations.

This proposal would be facilitated by shifting the AWS-4 uplink band up five megahertz, as discussed above. With the expanded ten megahertz of separation between AWS-4 uplink and PCS downlink operations, the interference potential should be sufficiently mitigated that there would be less need for additional power reductions to protect broadband PCS devices. Similarly, because the 2000-2005 MHz band would be used either as guard band or for legacy 2 GHz MSS

[14] LTE RF standard for user equipment, 3GPP TS 36.101 R10.5.0, at 33, available at http://www.3gpp.org/ftp/Specs/archive/36_series/36.101/36101-a50.zip (last visited April 26, 2012).

devices (which are not often used in close proximity to commercial mobile devices), there is no need to provide greater than usual protection for operations in that band.

IV. CONCLUSION.

Motorola Mobility supports the Commission's goal of promoting the introduction of mobile broadband services to the 2 GHz band through the creation of a new AWS-4. As discussed above, the new AWS-4 service rules should, to the greatest extent possible, be modeled on existing standards and rules and should also be designed to facilitate a rapid and efficient introduction of AWS-4 terrestrial operations.

Respectfully submitted,

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TECHNICAL APPENDIX

Deterministic Coexistence Analysis Between 3GPP Band 23 And Band 25 Devices:

Assumed path loss model, Free Space Path Loss (FSPL):

- FSPL (dB) = 20 log (d) + 20 log (f) – 27.55
- Where d = distance in meters, and f = frequency in megahertz |

For transmissions at 2000 MHz, path loss at a distance of 2 meters would be:

- FSPL (dB) = 20 log (2) + 20 log (2000) – 27.55 = **44.5 dB**

Band 23 device transmitter assumptions:

- Tx power = 23 dBm; Tx antenna gain = 0 dBi; Body loss = 10 dB

Band 25 device receiver assumptions:

- Rx antenna gain = 0 dB; Rx noise figure = 12.5dB[15]

Based on the noise figure of 12.5 dB, a power spectral density of terminal noise of -174 dBm/Hz, and assuming a 3 dB desensitization (allowed increase in noise floor due to interference):

- Maximum allowed interference at a Band 25 receiver = **-101.5 dBm/MHz**

Applying the above assumptions regarding path loss and performance characteristics of Band 23 transmitters and Band 25 receivers:

- Maximum allowed interference level at the Band 23 transmitter = **-47 dBm/MHz**

[15] Based on the defined reference sensitivity of -96.5 dBm for 3GPP Band 25 and a channel bandwidth of five megahertz. *See* 3GPP TS 36.101 V10.6.0 (2012-03), at Table 7.3.1-1, http://www.3gpp.org/ftp/Specs/2012-03/Rel-10/36_series/. In Table 7.3.1-1 of 3GPP TS 36.101, the reference sensitivity for Band 1 is based on a noise figure of 9 dB. The 3GPP specification allows a sensitivity relaxation of 3.5 dB for Band 25 due to higher front end losses, which results in a maximum allowed noise figure of 12.5 dB.

Conclusion:

This deterministic analysis of device-to-device interference suggests that a 3GPP Band 23 transmitter would have to maintain a PSD limit of -47 dBm/MHz to prevent harmful interference to a 3GPP Band 25 device with two meters of physical separation. This limit would be very challenging to meet when using a five or ten megahertz Band 23 LTE carrier with only five megahertz of frequency separation from the Band 25 device. For comparison, the general 3GPP spectrum emission mask would require a limit of -13 dBm/MHz at five megahertz from the channel edge.[16]

[16] *See id.* at Tbl. 6.6.2.1.1-1.